

Ting, Mingfang, Columbia University

Understanding and Attributing Tropical Cyclone Intensity and Frequency Changes in the 20th and 21st Centuries

2010

Abstract: We propose to provide a quantitative assessment of the role of forced versus natural SST variability on hurricane intensity and frequency changes in both the 20th and 21st Centuries, based on observational records as well as CMIP3 model simulations. The key hypothesis is that naturally varying and forced components of SST have distinctively different influences on tropical cyclone potential intensity and genesis potential index (related to hurricane frequency) that may explain the discrepancy in observed trend versus model projections of changes in hurricane intensity and frequency. The ultimate goal is to provide a better understanding and prediction of future changes in tropical cyclone intensity and frequency.

The change in intensity and frequency of tropical cyclones as a result of green house warming is a topic of great societal concern due to the disastrous nature of these storms. Recent observational studies based on the satellite era Atlantic hurricane records have shown a robust upward trend in Atlantic hurricane intensity. While many have argued for an increase in tropical cyclone intensity in the warming world due to the increasing SST, the actual projection of the potential intensity (PI), a theoretical upper limit of the cyclone intensity, of tropical cyclones based on CMIP3 models' 21st century simulations have not shown a consistent upward trend. The discrepancies are possibly due to the fact that both local and remote SST could contribute to the PI and the relative warming of the local SST may be more relevant in determining the PI, as previous studies indicated. We propose in this study to understand further the relation between SST and tropical cyclone PI by decomposing the effect of anthropogenically forced and the naturally occurring SST variability. Regarding hurricane frequency, there has been an upward trend in the Atlantic since 1980. However, recent model projections for Atlantic hurricane frequency are pointing towards a reduction of hurricane frequency under the 21st century conditions. A similar calculation to that of the PI will be applied using an empirical genesis potential index (GPI) as a measure of tropical cyclone frequency. The results of the study will help a more accurate projection and better understanding of the future frequency and intensity change in tropical cyclone activity based on model simulations and observations of the tropical SST variability.